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ABSTRACT

A three-part study was undertaken to determine the status of preservice elementary science education in New England. The first part ("Crisis in Elementary Science Education: New England") reports on a survey of New England teacher education institutions to determine the amount and types of science content and elementary science methods courses, program emphasis in science content, science processes and methods, science teaching techniques, effectiveness of science preparation, and general preparation as an elementary science teacher. The second part ("Elementary Science Education Library Resources in Graduate and Undergraduate Teacher Education Programs of New England") compared the library resources at 62 teacher education institutions. The third part ("Professional Preparation, Elementary Science Methods Course Content, and Professional Responsibilities of Preservice Educators") reports on New England elementary science methods faculty, including their professional preparation, content of their elementary science methods course, related work load responsibilities, and demographic information about the individual. Recommendations for resolving problems facing preservice elementary science education in New England are offered based on such findings as 15 percent of institutions not requiring elementary education majors to take a science content course and inadequate library resources for preservice elementary science education. An 18-item bibliography is included. (JN)

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DEMOGRAPHIC SURVEY OF NEW ENGLAND TEACHER EDUCATORS OF ELEMENTARY SCIENCE METHODS COURSES

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FORWARD

This study was undertaken to determine the status of preservice elementary science education in New England. It was sponsored by the University of Maine Faculty Development Research Fund. The data was collected just prior to and following the release of the Nation at Risk report. This could have influenced some of the responses.

There are three major sections to this study. The first part, "Crisis in Elementary Science Education: New England", surveyed administrators and was presented at the 1984 New England Educational Research Organization. The second component, "Elementary Science Education Library Resources in Graduate and Undergraduate Teacher Education Programs of New England", was presented at the 1984 National Association for Research in Science Teaching. This survey was completed by library directors. The final part focused upon the professional preparation, course content, and professional responsibilities of elementary science methods faculty. Overall conclusions, based upon the three substudies, are offered to provide guidance in resolving the problems facing preservice elementary science education in New England.

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Crisis in Elementary Science Education: New England

Introduction

Project Synthesis (Harms and Yager, 1981) summarized three National Science Foundation (NSF) studies related to science education. Weiss (1978) found that elementary science instruction was limited and many teachers perceived themselves as "not well qualified" to teach science. Helgeson, Blosser, and Howe (1977) found that lecture-discussion was the most common elementary science teaching strategy. Stake and Easley's (1978) case studies of elementary schools also found that science was not emphasized and frequently was ignored. Weiss' (1978) surveys of state science supervisors and elementary school principals found they concurred that elementary teachers were inadequately prepared to teach science.

Mechling, Stedman, and Donnellan (1982) surveyed the 50 institutions of higher education that had the largest number of teacher education graduates during the 1979-80 academic year (as identified by the American Association of Colleges for Teacher Education). Their survey was utilized to develop a position statement by the National Science Teachers Association (NSTA) concerning the preparation and certification of elementary school teachers of science. Mechling et al. found that all except one institution required elementary teachers to complete science courses, only 18% of the responding institutions required courses in each of the biological, earth, and physical sciences; 50% of respondents required eight hours of college science or less; and 81% of the institutions required their students to complete an elementary science methods course. They concluded it is imperative that faculty qualified in science and with elementary school experience teach science methods courses.

The Mechling et al. study resulted in the formulation of recommended

standards for preparing teachers of science at the elementary level (NSTA, 1983). This was the first major revision for preparation of elementary science teachers since the AAAS Commission of Science Education report in 1970. The following standards were approved by the 1983 NSTA Board of Directors in Dallas, Texas:

1. A minimum of 12 semester hours of laboratory or field-oriented science to include courses in the areas of biological, earth, and physical science should be required.
2. Courses should be adapted to the elementary education major by applying knowledge relevant to the elementary school classroom, by increasing skills in using science processes, and by encouraging a more positive attitude toward science instruction at the elementary school level.
3. A separate science methods course should be required of all graduates, with a minimum of three semester hours of credit. This course should promote process skill development, the ability to select appropriate science content for elementary students, the ability to design classroom environments which encourage a positive attitude, toward science, a variety of instructional strategies, and diverse evaluation strategies.
4. Field experiences should include science instruction.
5. The faculty member who teaches science content courses should have science credentials. Methods instructors should have specific training and experience in teaching elementary school science and have continuous involvement with elementary schools.
6. Preservice science instruction should occur in a laboratory setting.
7. Teachers should have a professional orientation toward science and science instruction.

The above standards are compatible with the elementary science teacher requirements delineated by Project Synthesis (Harm and Yager, 1981). That study recommended that teachers should have experience and knowledge of both science process and content, understanding of students' cognitive, psychomotor, and affective development, and of the importance of science in the students' growth and command of teaching strategies.

Procedures

The purpose of this study was to gather demographic data about New England teacher education institutions and their programs. Specifically, the study collected data about the amount and types of science content and elementary science methods courses, program emphasis in science content, science processes and methods, science teaching techniques, effectiveness of science preparation, and general preparation as an elementary science teacher. This study was undertaken because there were only two New England institutions utilized in the Mechling, et al. study.

A letter was sent to each New England Commissioner of Education requesting a list of all higher education institutions in their state that had elementary education programs. A 28 item survey was mailed to all 97 teacher education institutions of New England. This survey was a modification of Mechling's (1982) survey for the NSTA. The survey instrument, with cover letter and self-addressed stamped envelope, was sent during March, 1983. Two weeks later all non-respondents received a follow-up letter, survey, and self-addressed stamped envelope. After April 15, 1983, all non-respondents were contacted by telephone to determine whether they had received the surveys and to ascertain the names of library director and elementary science method instructor(s). These names were needed to mail other sub-study instruments. Survey processing followed established patterns (Berty, 1979). Ten of the institutions identified by state departments either did not have a functional

program, or prepared people only in special areas, i.e., art, music, etc. These ten institutions were deleted from the study. There was an 83% return rate from the 87 New England teacher education institutions that prepare elementary education teachers. A total of 47 (65.3%) of the 72 responding institutions have a graduate program.

The data was analyzed utilizing the Statistical Package for the Social Sciences (SPSSX, 1983). The FREQUENCIES and CROSSTABS subprograms provided the results reported below.

Data and Discussion

1. THE ELEMENTARY EDUCATION GRADUATES FROM YOUR INSTITUTION ARE CERTIFIED TO TEACH IN WHICH CATEGORY?

K - 6	25 (34.7%)
K - 8	16 (22.2%)
Other	27 (37.5%)
No response	4 (5.6%)

Most of the responses in the "other" category were overlapping either the K-6 or K-8 categories. For example, they provided programs to prepare teachers for grades: 1-6 (12), K-3 (3), pre-school-8 (2), K-9 (1), pre-school-9 (1), and 5-9 (1). A majority of these programs were from Massachusetts.

2. WHICH OF THE FOLLOWING DESCRIBES YOUR COLLEGE OR UNIVERSITY?

A public institution	31 (43.1%)
A private institution, church affiliated	19 (19.4%)
A private institution, non-church affiliated	27 (37.5%)

Slightly more than half the New England institutions are private while less than 1/5 are church affiliated.

3. WHICH OF THE FOLLOWING BEST DESCRIBES THE TREND IN YEARLY NUMBERS OF UNDERGRADUATE ELEMENTARY EDUCATION MAJORS GRADUATED FROM YOUR INSTITUTION DURING THE PAST FIVE YEARS?

Sharply decreased	13 (18.1%)
Sharply decreased, then leveled off	18 (25.0%)
Moderately decreased	22 (30.6%)
Remained fairly steady	14 (19.4%)
Moderately increased	3 (4.2%)
Sharply increased	1 (1.4%)
No Response	1 (1.4%)

More than 2/3 of the responding institutions have had a decrease in the number of students completing their programs. Only four of the institutions have had an increase in number of elementary education graduates. This pattern follows that which has been reported nationally.

4. WHAT ARE THE MINIMUM NUMBER OF SCIENCE HOURS REQUIRED IN YOUR ELEMENTARY EDUCATION PROGRAM (EXCLUDING THE SCIENCE METHODS COURSE)?

None	11 (15.3%)
1-3	6 (8.3%)
4-6	21 (29.1%)
7-9	20 (27.8%)
10-12	6 (8.3%)
More than 12	8 (11.2%)

The mean was 8.236 with a median of 6. The high mean was due to six institutions who reported they require more than 20 hours of science. The distribution was bimodal (6 and 8). More than 15% of the respondents do not require any science for their elementary certification.

5. ARE YOUR ELEMENTARY EDUCATION MAJORS REQUIRED TO TAKE AN ELEMENTARY SCIENCE METHODS COURSE?

Yes	53 (73.6%)
No	16 (22.2%)
No response	3 (4.2%)

More than 1/5 of New England teacher education institutions do not require their graduates to complete an elementary science methods course. In comparison to Mechling's study, only one of the responding 45 institutions did not require their graduates to complete an elementary science methods course.

6. WHICH OF THE FOLLOWING CHANGES HAS THE SCIENCE COMPONENT OF YOUR ELEMENTARY EDUCATION PROGRAM UNDERGONE DURING THE PAST FIVE YEARS?

Fewer course offerings Yes 3 (4.2%) No 66 (91.7%) No response 3 (4.2%)
Increased course offerings Yes 15 (20.8%) No 57 (79.2%)
Smaller class or section size Yes 32 (44.4%) No 40 (55.6%)
Larger class or section size Yes 3 (4.2%) No 69 (95.8%)
Decreased number of credits per course Yes 3 (4.2%) No 69 (95.8%)
Increased number of credits per course Yes 6 (8.3%) No 65 (90.3%)
No Response 1 (1.4%)
Decreased science education budgets relative to other components of teacher education Yes 1 (1.4%) No 71 (98.6%)

Increased science education budgets relative to other components of teacher education — Yes 2 (2.8%) No 70 (97.2%)

Other: 21 (29.2%)

- Remains the same
- More time in science/math methods course
- Decrease budget
- Greater student choice
- More hours in natural science
- Required science courses
- Use workshops to meet science requirement
- Part of block program
- Health, nutrition, and safety
- Less frequent offerings of science methods
- Survey science courses
- More field-based emphasis

Overall, New England institutions have had a reduction in class size (44%). Otherwise, the science component is considered status quo.

7. ARE ELEMENTARY TEACHER CANDIDATES REQUIRED TO TAKE SCIENCE COURSES AS A PART OF THEIR GENERAL EDUCATION REQUIREMENTS, THEIR PROFESSIONAL EDUCATION REQUIREMENTS, OR BOTH?

	New England	Mechling
General education	28 (38.9%)	18 (41%)
Professional Education	8 (11.1%)	2 (5%)
Both	33 (45.8%)	24 (54%)

The results from the responding New England institutions are fairly similar to Mechling's findings.

8. IN WHICH OF THE FOLLOWING AREAS ARE ELEMENTARY TEACHER CANDIDATES REQUIRED TO TAKE COURSES?

	New England	Mechling
Physical sciences	3 (4.2%)	18 (22%)
Biological sciences	2 (2.8%)	19 (23%)
Earth sciences	6 (8.3%)	20 (12%)
Any of the above may be elected	36 (50.0%)	21 (25%)
All of the above are required	2 (2.8%)	8 (9%)
Other	21 (29.2%)	8 (9%)
No response	2 (2.8%)	

In comparison to Mechling's findings, New England institutions provide greater option in the choice of which science courses are required of their graduates. Considerably less New England students are required to have specific courses than Mechling reported. Half of the New England institutions allow their students to determine which science courses

they can take. Consequently, it is possible for students to take courses only in one discipline rather than from physical, biological, and earth science domains. Other responses of campus requirements included: Two electives (with labs), biological science allowing a choice between chemistry and physics, a course in nutrition, integrate into curriculum course, a science method course that focuses on many science disciplines, lab courses only, general science course for elementary education majors, or a physical science course plus an elective.

9. HOW MANY OF THE SCIENCE CONTENT COURSES REQUIRED OF ELEMENTARY EDUCATION MAJORS MUST INCLUDE LABORATORY WORK? (CHECK ONE)

None	17 (23.6%)
One	20 (27.6%)
Two	23 (31.9%)
Other	9 (12.5%)
No response	3 (4.2%)

Almost one-fourth of elementary education majors' science courses do not require a laboratory component. On a positive side, more than three-fourths of the institutions require one or more laboratory-oriented science courses.

10. ARE SPECIFIC SCIENCE COURSES EXCLUDING SCIENCE METHODS REQUIRED?

Yes 25 (39.7%) No 43 (59.7%) No response 4 (5.6%)

The following are the required science courses at the responding institutions:

Type	Number
Biological Science	11
Physical Science	9
General Science	9
Earth Science	2
Environmental Science	2
Human Biology	1
Nutrition	1
Teaching Process	1
Math	1

Biological, physical, and general science courses are the most common science courses required for elementary education majors at New England institutions. Some institutions require more than one specific science course. This researcher would not categorize teaching process and math as science content courses; however, two New England institutions' department leaders did.

11. IF SCIENCE COURSES ARE REQUIRED, ARE THEY DESIGNED SPECIFICALLY TO MEET THE NEEDS OF PRESERVICE ELEMENTARY TEACHERS?

Yes 25 (34.7%) No 43 (59.7%) Other 3 (4.2%) No Response 1 (1.4%)

The results are very similar to Mechling. He found that 59% of the responding institutions had no specifically designed courses while 37% did have specific courses.

12. DO ELEMENTARY TEACHER CANDIDATES USUALLY ELECT ADDITIONAL SCIENCE COURSES ON THEIR OWN?

Yes 19 (26.4%) No 47 (65.3%) No response 6 (8.4%)

These results differ considerably from Mechling, who found that 98% of the institutions did not have students taking more than the minimum number of science courses.

13. DO THE SCIENCE COURSES TAKEN BY ELEMENTARY TEACHER CANDIDATES INCLUDE LABORATORY EXPERIENCES AND ACTIVITIES IN ADDITION TO LECTURE?

Yes 54 (75.0%) No 12 (16.7%) No response 6 (8.3%)

These results are almost identical to Mechling who found that 73% included laboratory experiences with their science classes while 16% did not have laboratory opportunities.

14. IN YOUR ESTIMATION, WHAT FACTORS HAVE HAD THE MOST INFLUENCE IN DETERMINING THE SCIENCE AND/OR SCIENCE TEACHING METHODS COURSE REQUIREMENTS FOR ELEMENTARY TEACHER CANDIDATES AT YOUR INSTITUTION? (CHECK ALL THAT APPLY).

Tradition	Yes 34 (47.2%) No 38 (52.8%)
Accreditation agencies such as NCATE	Yes 21 (29.2%) No 51 (70.8%)
State certification guidelines	Yes 37 (51.4%) No 35 (48.6%)
Professional Science Association guidelines	Yes 13 (18.1%) No 59 (81.9%)
Other 26 (36.1%)	

State certification guidelines and tradition are the two major factors for determining the scope and sequence of the science education program. Mechling also found these two factors to be the most important. Less than 1/5 of the institutions in both studies were acquainted with professional science association guidelines. The dominant "other" factor that determined the science requirement for elementary education graduates was the education faculty. This was the only "other" factor mentioned more than twice. Additional other factors mentioned were: Science faculty have developed courses for elementary education majors, classroom teachers identified the need for better science instruction, provide opportunity to apply learning theory to science education, new state requirement, institution regulation, and alumni.

15. IN YOUR PROGRAM, HOW MUCH EMPHASIS IS CURRENTLY PLACED ON THE FOLLOWING SCIENCE EDUCATION AREAS?

	Much	Some	Little	Don't Know	No Response
Science Content:					
New England	21 (29.2%)	39 (54.2%)	7 (9.7%)	1 (1.4%)	4 (5.6%)
Mechling	14 (31%)	22 (49%)	9 (20%)	0 (0%)	
Science Process & Methods:					
New England	27 (37.5%)	35 (48.6%)	5 (6.9%)	2 (2.8%)	3 (4.2%)
Mechling	28 (62%)	15 (33%)	2 (5%)	0 (0%)	
Science Teaching Techniques:					
New England	23 (31.9%)	36 (50.0%)	8 (11.1%)	1 (1.4%)	4 (5.6%)
Mechling	30 (67%)	12 (27%)	3 (6%)	0 (0%)	

In comparing the New England institutions with Mechling, there is a great deal of similarity concerning science content. However, Mechling responses found greater emphasis on science process and methods and science teaching techniques. Fifty-five % or more of the New England respondents indicated that content, processes and methods, and teaching techniques received some or little emphasis. The New England respondents

found almost equal emphasis in content, process and methods, and teaching techniques in the "much" category while Mechling found that emphasis on process and methods, and teaching techniques had a two-to-one in favor emphasis when compared to content.

16. DO YOU THINK YOUR SCIENCE CREDIT HOUR REQUIREMENTS FOR PRESERVICE ELEMENTARY EDUCATION MAJORS SHOULD BE CHANGED?

	No change needed	More is needed	Less is needed	No Response
Science Content:				
New England	36 (50.0%)	30 (41.7%)	1 (1.4%)	5 (6.9%)
Mechling	18 (41%)	26 (58%)	0 (0%)	
Science Processes & Methods:				
New England	31 (43.1%)	31 (43.1%)	2 (2.8%)	8 (11.1%)
Mechling	23 (52%)	21 (48%)	0 (0%)	
Science Teaching Techniques:				
New England	34 (47.2%)	28 (38.9%)	2 (2.8%)	8 (11.1%)
Mechling	22 (50%)	22 (50%)	0 (0%)	

Almost 40% or more of the New England respondents perceived need for more science content, process and methods, and teaching techniques.

17. AS YOU CONSIDER YOUR TOTAL PROGRAM FOR PREPARING PRESERVICE ELEMENTARY TEACHERS FOR TEACHING SCIENCE, HOW WOULD YOU RATE ITS OVERALL EFFECTIVENESS?

	New England	Mechling
Excellent	10 (13.9%)	5 (11%)
Good	29 (33.3%)	24 (55%)
Adequate	25 (34.7%)	12 (27%)
Poor	11 (15.3%)	3 (7%)
Don't Know	2 (2.8%)	0 (0%)

Less than half of the New England respondents rank their science preparation program as excellent or good while more than two-thirds of Mechling respondents classified their program as excellent or good. Almost half of the New England respondents rank their program as adequate or poor while in Mechling's study about one-third gave the same rank.

20. ARE ALL ELEMENTARY GRADUATE STUDENTS REQUIRED TO COMPLETE A SCIENCE EDUCATION COURSE?

Yes	11 (15.3%)
No	29 (40.3%)
No response	32 (44.4%)

Since only 65% of the New England institutions offer a graduate program, only a small percentage of individuals are required to complete a science education class.

The most common course was similar to undergraduate elementary science methods courses. "Other" courses were: Teaching Science as a Process, Methods and Materials in Elementary School Science, Curriculum and Instruction in Math and Science, any curriculum course, and Math and Science for Teachers.

21. MY INSTITUTION'S ELEMENTARY EDUCATION PROGRAM IS CURRENTLY: (CHECK ALL THAT APPLY)

New England Association of Schools and Colleges (NEASC) approved
Yes 42 (58.3%) No 29 (40.3%) No Response 1 (1.4%)

NCATE approved Yes 27 (37.5%) No 43 (59.7%) No Response 2 (2.8%)

State Certification approved Yes 61 (84.7%) No 10 (13.9%)
No Response 1 (1.4%)

Currently on Probation Yes 2 (2.8%) No 69 (95.8%) No Response 1 (1.4%)

Other: Yes 13 (18.1%) No 58 (80.6%) No Response 1 (1.4%)

Almost 85% of the responding institutions were approved by their state certification program. Slightly less than 60% and 40% were approved by NEASC and NCATE respectively. Only two of the institutions currently were on probation.

22. IS YOUR INSTITUTION CURRENTLY REDESIGNING ITS UNDERGRADUATE ELEMENTARY EDUCATION PROGRAM? Yes 26 (36.1%) No 43 (59.7%) No Response 3 (4.2%)

The two major program changes reported were increasing the science emphasis and adding computer literacy. These two categories comprise almost one-third of the redesign changes. Other changes included: More content (liberal arts), reduce education requirements, interdisciplinary approach to science methods, field-based program, collaboration between education and science faculty to develop science course(s) for elementary eduction majors, offer separate science and mathematics methods courses, greater emphasis upon primary school application, and require course in teaching of math and science.

Several respondents indicated they had recently completed a revision of their program.

23. TO WHAT EXTENT DOES YOUR PROGRAM EVALUATE THE EFFECTIVENESS OF YOUR ELEMENTARY TEACHER PREPARATION PROGRAM IN SCIENCE EDUCATION BY FOLLOW-UP STUDIES OF YOUR GRADUATES? (CHECK ONE)

None	17 (23.6%)
Little	27 (37.5%)
Moderate	19 (26.4%)
Extensive	4 (5.6%)
No Response	5 (6.9%)

Slightly more than five percent of the New England institutions conduct extensive follow-ups of how their graduates are performing with regard to science education. The data indicates that respondents have limited follow-up information about the effectiveness of their science education program.

23a. IF YOU DO FOLLOW-UP STUDIES OF YOUR GRADUATES, WHICH OF THE FOLLOWING METHODS(S) DO YOU USE FOR EVALUATION? (CHECK ALL THAT APPLY)

Informal discussion and contacts Yes 35 (48.6%) No 36 (50.0%)
No Response 1 (1.4%)

Written questionnaires sent to graduates Yes 45 (62.5%) No 26 (36.1%)
No Response 1 (1.4%)

Classroom visitations of teacher graduates Yes 9 (12.5%) No 63 (87.5%)

Return visits by graduates Yes 27 (37.5%) No 44 (61.1%) No Response 1 (1.4%)

For those institutions that conduct follow-up studies, most of their information comes from graduates responses to questionnaires and/or informal encounters. Less than 15% made direct teacher observation of their graduates to determine the programs effectiveness.

24. ALL THINGS CONSIDERED, HOW COULD ELEMENTARY TEACHER CANDIDATES BE BETTER PREPARED TO TEACH SCIENCE AT YOUR INSTITUTION?

Twenty-eight of the respondents perceived the need for more science content to be the most crucial need at their intitution. Eleven respondents specified the offering of a science course(s) with a hands-on problem-solving emphasis as the most needed addition, and ten respondents

identified a separate science methods course as being badly needed. Seven respondents mentioned the public schools apathy toward science. None of the following responses were mentioned by more than three institutions:

Increase practicum requirements
Totally field-based program
Fifth year program
General science course
Promote science and math enthusiastically
Integration between education and science faculty
Better mathematical background
Science faculty who have emphathy for the science anxious student
Require earth science
Support for crisis movement in science education
NSF supported institutions
More required science laboratories
More money
Greater interrelationship between method courses
Require high school science prior to college
Science-Business cooperation

The top three comments from New Englands institutions also were found in Mechling's study. However, he found the percentage suggesting more science courses to be considerably less (20%) than was recommended by New England respondents in the present study.

Conclusions

Several patterns emerged from analysis of this data. A total of 15.3% of the responding institutions do not require their elementary education majors to take any science class. More than 25% of the New England institutions fail to offer an elementary science methods course for their elementary education majors. Laboratory science courses are not required by 23.6% of the institutions.

Almost 60% of the responding New England institutions allow elementary education majors a choice of whether to take biological, earth, or physical science. Of these New England institutions, almost 35% have science content courses specifically designed for elementary education majors. More than 25% of the institutions indicated many of their students completed additional

science content courses. Science content courses with laboratories were found at 75% of the institutions. The responding institutions perceived their programs as placing more emphasis on science process and methods than on science content and/or science teaching techniques. Of these programs, 50% perceived no change was needed in science content while 42% thought more was needed; there was an equal balance between those feeling no change was needed and those feeling more is needed concerning science process and methods; and 48% perceived no change was needed while 39% perceived more science teaching techniques were needed.

Each of the responding institutions rated their overall effectiveness in preparing elementary teachers for teaching science. Less than half of the institutions ranked their program as excellent or good. Half of the respondents ranked their program as adequate or poor. Of the programs that offered a graduate degree, 15% required their graduate students to take a graduate science methods course.

Each respondent was provided an opportunity to list changes of the highest priority to improve his/her science preparation program for future elementary teachers. The highest priority was providing students with more science content followed by a problem-solving oriented science course specifically designed for elementary education majors. The third highest priority listed was the offering of an elementary science methods course.

Implications

This study filled a void in the Mechling et al. study (1982), by gathering data about New England teacher education programs in elementary science education.

Overall, this study found the quality of elementary science preparation in New England was inferior to that found by Mechling et al. in the 50 largest teacher education institutions. It is possible that resources at large institutions allow for greater specialization, i.e., elementary science methods faculty. It is discouraging that more than 25% of New England institutions fail to offer a science methods course for their elementary education majors. Regardless of size, each higher education institution does offer science courses, yet 15% of the New England institutions do not require their elementary education majors to take a science content course.

These two major findings do not appear to be resolving the crisis in science education. All New England institutions should be preparing their graduates to teach elementary science and should require them to have a science background. If preservice science education is inferior, how can we resolve teachers frustrations about teaching science? As future teachers, will they be able to prepare their students to be scientifically literate?

Elementary Science Education Library Resources in Graduate and Undergraduate Teacher Education Programs of New England

Introduction

The recent National Science Board report (1983) addressed the need for quality science education to begin at the elementary level. This is essential because by the end of third grade, students' attitudes toward science are established (Hurd, 1983). Walton (1983) in the Education Week special report on mathematics and science education summarized the poor status of science education in the K-6 classroom. In support of this, Mechling (1982) found that more than 50 percent of largest teacher education programs in the United States needed more emphasis on science content, science processes and methods, and science teaching techniques.

The AAAS Commission on Science Education, (Herron 1970) recommended that preservice elementary science teachers should develop "...habits of continually seeking new information" (p. 20). One of the campus resources that provides preservice teachers opportunities to develop this charge is the quality of the library. Yager in his study of graduate science education programs (1982) did not ascertain information about library resources. An ERIC computer search found no published reports on library resources as they relate to science education.

Procedures

The purpose of this study was to compare elementary science education library resources in graduate and undergraduate teacher education institutions in New England. A 31 item survey was developed for library directors of New England institutions. The instrument was reviewed by two science educators and two library educators. The survey instrument with cover letter and self-addressed stamped envelope was sent during April, 1983. Two weeks later all non-respondents received a follow-up letter, survey, and self-addressed stamped envelope. Berty's (1979) guidelines were followed in processing the survey. There was a 72% return rate from the 87 teachers'

education institutions of New England that had certified elementary education programs.

Prepared programs from the Statistical Package for the Social Sciences (SPSSX, 1983) were utilized for data analysis. Of the 62 responding institutions, 42 (68%) had graduate education programs. Only three of the 42 graduate programs had no elementary science methods course while five of the 20 undergraduate institutions failed to offer an elementary science methods course to their students.

Results

Differences were found between graduate and undergraduate institutions. More than 75% of the surveyed graduate institutions had Education Index, CIJE, ERIC, and Dissertation Abstracts, while only Education Index was available in more than 75% of the undergraduate institutions (Table 1). School Science and Mathematics, Science and Children, Science Education, Science News, and The Science Teacher were the only science education journals available at more than 75% of the graduate institutions. Science News was the only science education journal available at more than 60% of the undergraduate institutions (Table 2). Arithmetic Teacher, Instructor, Language Arts, The Reading Teacher, and Teacher were available at more than 2/3 of the graduate and undergraduate institutions (Table 3).

The results of this study found library resources available for preservice elementary science education to be inadequate with the exception of fiction science trade books at undergraduate institutions and science reference books at both undergraduate and graduate institutions. Both graduate and undergraduate institutions gave a higher rating for their K-6 science textbooks published prior to 1980 than for those published after 1980. Both graduate and undergraduate institutions were severely lacking in science computer software (Table 4).

For the library resources comparison, the "adequate" and "more than adequate" categories were grouped together, and the "inadequate" and "not available" categories formed the other group. Differences between resources, journals, and support resources in graduate and undergraduate libraries are found in Table 5. Significant differences were found for ERIC, ERIC microfiche availability, Dissertation Abstracts, and computer search capabilities for resources. Young Children was the only non-science journal where there was a significant difference, while for the Journal of Research in Science Teaching, Science Education, and The Science Teacher there were significant differences between graduate and undergraduate institutions. There was no significant difference for support resources.

Insert Tables 1-5 about here

Conclusion and Implications

Since there are not additional published articles on science education library resources, it is difficult to determine whether New England institutions are typical or atypical. A broader concern than libraries is that eight of the 62 institutions fail to offer an elementary science method course. Graduates of about 13% of these institutions will become elementary teachers without being prepared to teach science. These graduates probably will continue poor teaching patterns regarding science (i.e. textbook bound, teaching without manipulates, not teaching science at all, etc).

Additional studies are needed to determine the quality of graduate studies where institutions lack ERIC microfiche, Dissertation Abstracts, and computer search capabilities. How can graduate students and faculty conduct research without these resources? Are these graduates being prepared to utilize research results? The Journal of Research in Science Teaching, the

most important journal for science education researchers, is absent in almost 40% of the reporting libraries. In addition, Science Education and School Science and Mathematics are unavailable in more than 20% of the graduate libraries, and almost half of the undergraduate institutions fail to have Science and Children available for their elementary education majors. Overall, the journals available to elementary education students are lacking in science education information for both graduate and undergraduate institutions. How are preservice students to develop the habit of seeking new information when appropriate journals are unavailable?

It is unfortunate that preservice students visit their campus libraries to examine science textbooks and find there are more K-6 science textbooks published before 1980 available to them than more recent ones. These students might not be prepared to deal with the more modern editions. Preservice students might judge the quality of science resources based upon a text that is no longer available and, consequently, a distorted view of science education.

Librarians were aware of the need to improve science education at their institutions. In response to an open-ended question about their top five priorities, they identified computer software and audiovisuals as the top two. The availability of these resources would facilitate the preparation of elementary science teachers.

Insert Table 6 about here

The results of this study illustrate the need to improve the science education resources, journals, and support resources at New England teacher education libraries. By improving their library's quality in science education, teacher education institutions will be helping to address the crisis in science education.

Table 2
Science Education Journals Available at New England Graduate, Non-graduate and Composite Teacher Education Institutions

	Graduate		No Graduate Program		Composite		No Response	
	n	%	n	%	n	%	n	%
Journal of Research in Science Teaching	25	61.0	3	14.3	28	45.2	0	0
School Science and Mathematics	32	78.0	118	52.4	43	69.4	0	0
Science Activities	76	17.1	2	9.5	98	14.5	0	0
Science and Children	32	78.0	110	52.4	43	69.4	0	0
Science Digest	28	68.3	12	57.1	40	64.5	0	0
Science Education	31	75.6	6	28.6	37	59.7	0	0
Science News	36	87.6	19	90.5	55	88.7	0	0
The Science Teacher	34	82.9	10	47.6	44	71.0	0	0

Table 4

Librarian's Preceived Quantities of Resources Available at New England Graduate, Non-graduate, and Total Teacher Education Institutions

	Graduate		No Graduate Program		Total	
	X	S.D.	X	S.D.	X	S.D.
	n = 41		n = 21		n = 62	
Elementary Science Textbooks Prior to 1980	2.105	1.034	2.300	1.081	2.172	1.045
1980 +	2.564	0.852	2.579	1.261	2.569	0.993
Non fiction Science Trade Books	2.150	0.949	2.105	1.197	2.136	1.025
Fiction Science Trade Books	2.350	1.051	1.895	1.329	2.203	1.156
Resource Files on Current Science Topics	2.675	0.944	2.300	1.081	2.550	0.999
Science Reference Books	1.846	0.709	1.947	0.970	1.879	0.796
Audio-visuals Materials for Science	2.775	0.862	2.474	0.964	2.678	0.899
Computer Software for Science	3.395	0.887	3.444	1.149	3.411	0.968

Professional Preparation, Elementary Science Methods Course Content, and Professional Responsibilities of Preservice Educators

Introduction

The teacher as a key component in a successful education has been a slogan for several decades. What are the attributes of a "good" elementary science methods instructor? To find this answer, an ERIC computer search was conducted; however, no research studies were found concerning the preparation and professional experiences of elementary science methods instructors or typical course content of elementary science methods classes.

To develop a "model" elementary science methods instructor, the recent commission reports were reviewed. The report of the conference on Goals for Science and Technology Education Grades K-12 (1983) recommended that preservice courses should include hands-on experience, should utilize activities that enhance questioning, and should promote creative skills and problem-solving skills while developing an understanding of the individual. They recommended specific training in bulletin boards, learning centers, managing equipment, and use of resources. The National Science Board (1983) utilized this conference report when it recommended that future elementary teachers should have a background in liberal arts, education courses where exemplary teaching strategies are being utilized, and internships with highly qualified teachers.

The NSTA's recommendations for the preparation of elementary science teachers (1983) specified that science methods courses should include hands-on experiences that promote process skills development. These courses should promote proper selection of appropriate science topics for that particular grade level, design of classroom environments that promote positive attitudes, selection and use of a variety of instructional strategies, and development of techniques for evaluating pupil progress in science. For methods instructors, NSTA recommended that they have specific training and experience in the teaching of science and have continuous involvement with

elementary schools. In addition, methods instructors must be qualified, experienced, and interested in providing high-quality instruction. This providing high-quality instruction. This was the first revision of elementary science preparation standards since the AAAS guidelines (1970).

Goodlad (1983) noted that there is a need for upgrading the pedagogical competencies of future teachers. In addition, he reported that science was the only subject elementary teachers perceived themselves to be rather poorly prepared to teach. This supported similar findings of Weiss (1978).

Using the above sources, a model elementary science methods instructor should have a background in a science discipline, teaching experience at the elementary school level, and should be able to utilize a hands-on approach in teaching.

Procedures

The purpose of this study was to gather demographic data about New England elementary science methods faculty. Specifically, the study collected data about the faculty member's professional preparation, content of their elementary science method course, related work load responsibilities, and demographic information about the individual.

A 77 item questionnaire was developed during the Spring semester, 1983. Questionnaire was reviewed by three science education faculty for validity. Suggestions by the reviewers were incorporated into the final form. The survey instrument with cover letter and self-addressed, stamped envelope, was sent during April, 1983. Surveys were mailed directly to each elementary science methods instructor at the 87 New England teacher education institutions. Two weeks later all non-respondents received a follow-up letter, survey, and self-addressed, stamped envelope. Since there was only a 40% return rate, a second follow-up letter, survey, and self-addressed, stamped envelope was mailed in September, 1983. The final date for accepting the return surveys

was October, 1983. There was a total of 54 returned surveys from 91 available faculty, providing a 59% return. One part-time faculty member taught at two institutions and provided different responses only for content of the elementary science methods course. Berty's (1979) guidelines were followed for processing the surveys.

The data was analyzed utilizing the Statistical Package for the Social Sciences (SPSSX, 1983). The FREQUENCIES subprogram provided the results reported below.

Data and Discussion

Preparation:

1. YOUR HIGHEST DEGREE RECEIVED IS:

Masters	18 (33.3%)
C.A.S.	2 (3.7%)
Doctorate	33 (61.1%)
No Response	2 (1.9%)

YEAR RECEIVED:

1954	2 (3.7%)
1958	1 (1.9%)
1960	1 (1.9%)
1963	2 (3.7%)
1964	2 (3.7%)
1966	4 (7.4%)
1967	3 (5.6%)
1968	2 (3.7%)
1969	2 (3.7%)
1970	4 (7.4%)
1971	3 (5.6%)
1972	8 (14.8%)
1973	3 (5.6%)
1974	3 (5.6%)
1975	3 (5.6%)
1976	4 (7.4%)
1978	2 (3.7%)
1979	2 (3.7%)
1981	1 (1.9%)
1982	1 (1.9%)
No Response	1 (1.9%)

ARE YOU CURRENTLY PURSUING AN ADVANCED DEGREE?

Yes	6 (11.1%)
No	47 (87.0%)
No Response	1 (1.9%)

Three-fifths of the responding elementary science education faculty currently have a doctorate. Slightly more than 1/10 of the faculty are currently

pursuing a degree. One-third received their highest degree more than 17 years ago. More than half of the faculty received their highest degree since 1971. Only six faculty members received their highest degree within the past five years.

As expected, a majority of the elementary science methods faculty received their highest degree from a New England institution. The information below summarizes institutions by regions for the responding faculty. The numbers in parenthesis are those without a doctorate. The first number is the total number of faculty with graduate degrees (masters, C.A.S., and doctorate).

New England		Mideast	
Boston University	9 (2)	Columbia Teacher's College	3
Univ. of Connecticut	3	Temple University	2 (1)
Boston College	3	Cornell	1 (1)
Harvard	3	St. Bonaventure	1 (1)
Univ. of Mass.-Amherst	3 (1)	New York University	1
Univ. of New Hampshire	2 (1)	Syracuse University	1
University of Me.-Orono	2 (1)	Wells College	1 (1)
Lesley College	1 (1)	Bryn Mawr College	1
University of Vermont	1	n=10	
Castleton State College	1 (1)		
Fitchburg State College	1 (1)		
Rivier College	1 (1)		
Keene State College	1 (1)		
Antioch	1 (1)		
Univ. of Hartford	1 (1)		
n=33			

Midwest		Other Regions	
University of Michigan	2	Univ. of California-Berkeley	1
University of Iowa	2 (1)	University of Florida	1
University of Indiana	1	Union Graduate School	1
Ohio State University	1	n=3	
University of Illinois	1		
Wester Michigan Univ.	1		
n=8			

2. IS YOUR TERMINAL DEGREE IN SCIENCE EDUCATION?

Yes	21	(38.9%)
No	32	(59.3%)
No Response	1	(1.9%)

Less than 40% of the elementary science methods faculty have their highest degree in science education. The following areas were areas of specialization for the faculty member's terminal degree:

Elementary Education	7
Educational Administration	4
Mathematics/Mathematics Education	2
Curriculum and Instruction	2
Curriculum Development-Early Childhood	2
Early Childhood	2
Biology	2
Special Education	2
Social Studies Education	1
Zoology	1
Physics	1
Sociology	1
Environmental Education	1
Child Development	1
No Response	3

3. DID YOU EVER TEACH IN AN ELEMENTARY CLASSROOM?

Yes	43	(79.6%)
No	10	(18.5%)
No response	2	(1.9%)

IF YES, HOW MANY YEARS DID YOU TEACH IN AN ELEMENTARY CLASSROOM?

None	13	(24.1%)
1	4	(7.4%)
2	9	(16.7%)
3	4	(7.4%)
4	1	(1.9%)
5	8	(14.8%)
6	3	(5.6%)
7	3	(5.6%)
8	1	(1.9%)
10	2	(3.7%)
12	1	(1.9%)
15	2	(3.7%)
16	1	(1.9%)
19	1	(1.9%)
28	1	(1.9%)

WHAT GRADE LEVELS DID YOU TEACH?

Kindergarten	10	(18.5%)
First	11	(20.4%)
Second	13	(24.1%)
Third	10	(18.5%)
Fourth	23	(42.6%)
Fifth	27	(50.0%)
Sixth	29	(53.7%)

WHAT WAS THE LAST YEAR YOU TAUGHT IN AN ELEMENTARY CLASSROOM?

1958	1 (1.9%)
1961	1 (1.9%)
1962	1 (1.9%)
1965	3 (5.6%)
1966	2 (3.7%)
1967	4 (7.4%)
1968	2 (3.7%)
1969	3 (5.6%)
1970	1 (1.9%)
1971	2 (3.7%)
1972	2 (3.7%)
1974	1 (1.9%)
1975	2 (3.7%)
1976	1 (1.9%)
1977	2 (3.7%)
1978	1 (1.9%)
1980	1 (1.9%)
1981	1 (1.9%)
1983	6 (11.1%)
No response	17 (31.5%)

More than 3/4 of the elementary science methods faculty have taught in an elementary classroom. The mean number of years of teaching in an elementary classroom was nearly six ($\bar{X}$ = 5.952 with S.D. = 5.670). More than 60% of the faculty had taught five years or less in an elementary classroom. The faculty had more experience teaching in an intermediate classroom (grades 4-6) than in an early childhood classroom (K-grade 3). Essentially half of the respondents had taught in a fifth and/or sixth grade classroom. Slightly more than 1/3 of the respondents had not been an elementary classroom teacher within the past 15 years. The median last year that the respondents taught in an elementary classroom was 1972. Excluding those still currently teaching in an elementary classroom only three respondents had taught in an elementary classroom since 1978.

4. SINCE YOU COMPLETED YOUR BACHELOR'S DEGREE, HOW MANY SEMESTER HOURS HAVE YOU COMPLETED:

Hours	In Science?		In Science Education?	
0-9	14	(25.9%)	19	(35.2%)
10-18	7	(13.0%)	11	(20.4%)
19-27	3	(5.6%)	1	(1.9%)
more than 27	21	(38.9%)	16	(29.6%)
No response	9	(16.7%)	7	(13.0%)

Almost 2/5 of the responding faculty had more than 27 hours of science while about 1/4 had nine hours or less of science. Less than 1/3 of faculty had more than 27 hours in science education and slightly more than 1/3 had nine hours or less of science education in their professional preparation. Overall, the respondents had more preparation in science (19 hours and more) and less in science education (18 hours or less). While Miner (1982) reported that the majority of his respondents had a science education background.

The typical faculty load per year as determined by means would be elementary science methods (X = 1.635), secondary methods (X = .333), other education courses (X = 1.341), science courses (X = .861), science for non-science major (X = .600), supervision of student teachers (X = 7.343 students), graduate courses (X = .829), research and development release load (X = .250), and other responsibilities (X = .618).

The other education courses taught are very diverse. There is no pattern as to the types of courses. The courses and number of respondents with this responsibility are:

Foundations/General Education	9
Social Studies Methods	5
Child Development	5
Learning Theories	5
Secondary Methods	3
Mathematic Methods	3
Philosophy	2
Language Arts/Math/Social Studies Methods	2
Health Education	2
Reading Methods	2
Early Childhood Education	2
General/Adolescent Psychology	2
Language Arts Methods	1
Practicum Supervision	1
Special Education	1
Computers	1

Professional

1. PLEASE SUMMARIZE YOUR COURSE LOAD RESPONSIBILITIES FOR THE 1982-83 YEAR. SPECIFY NUMBER OF SECTION FOR EACH CATEGORY.

Total Sect.	Elem. Meth.	Sec. Meth.	Other Educ.	Sci.	Science non-sci. major	Grad.	Res.& Dev.	Other Respon.
0	3 (5.6%)	43 (79.6%)	25 (46.3%)	42 (77.7%)	44 (81.4%)	37 (68.5%)	48 (89.9%)	41 (75.9%)
1	29 (53.7%)	10 (18.5%)	12 (22.2%)	1 (1.9%)	4 (7.4%)	9 (16.7%)	4 (7.4%)	7 (13.0%)
2	16 (29.6%)	1 (1.9%)	14 (25.9%)	6 (11.1%)	4 (7.4%)	5 (9.3%)	2 (3.7%)	5 (9.3%)
3				2 (3.7%)	2 (3.7%)	2 (3.7%)		
4	6 (11.1%)		2 (3.7%)	3 (5.6%)		1 (1.9%)		
5								
6								
7			1 (1.9%)					

NUMBER OF STUDENT TEACHERS SUPERVISED:

0	35	(63.7%)
2	3	(5.5%)
4	1	(1.8%)
5	1	(1.8%)
6	1	(1.8%)
8	2	(3.6%)
10	1	(1.8%)
12	1	(1.8%)
13	2	(3.6%)
14	3	(5.5%)
16	2	(3.6%)
20	1	(1.8%)
30	1	(1.8%)
48	1	(1.8%)

The science courses taught by elementary science methods faculty include courses in physical, earth, and life sciences. The courses and frequencies are:

Physical Science	
Physical Science	2
Physics	1
Earth Science	
Astronomy	2
Oceanography	2
Meteorology	1
Life Science	
Biology	3
Physiology	2
Entomology	1
Anatomy	1
Human Biology	1
Nutrition	1
Neurophysiology	1
Other	
USMES	1
History of Science	1

Science courses for non-science majors are less frequently taught by elementary science methods faculty.

Graduate course responsibilities for elementary science methods faculty include courses in science content (i.e., nutrition), science education, and other areas within the faculty member's specialization. The science education courses included: methods and materials for science, science methods, seminars, and environmental education. Additional courses focused upon microcomputers and computer literacy, early childhood courses, Piaget, creativity, general education, social foundations, gifted and talented, day care preparation, children's literature, educational measurement, and curriculum dynamics.

Other responsibilities and frequencies of elementary science methods faculty include: directing a British exchange (2), department chair (2), director of student teaching (2), director of lab school (1), supervision of senior

research (1), math content courses (1), computer science courses (1), certification officer (1), and preparation for a sabbatical (1).

In summary, the responding elementary science methods faculty are not specialists; they are generalists. Their workloads are very diverse and require diverse backgrounds. A typical elementary science methods faculty member appears to have more than three different preparations per semester. On the average each faculty member teaches less than two sections of elementary science methods per year. This heavy workload preparation could contribute to the low journal publication record, science education conference presentation/participation, and inservice contributions for science. This will be discussed later.

2. CHECK THE APPROPRIATE RESPONSE FOR EACH OF THESE CATEGORIES FOR YOUR ELEMENTARY SCIENCE METHODS COURSE:

	Major Emphasis	Moderate Emphasis	Little Emphasis	Not Included	No Response	X
Science Processes	42 (76.4%)	7 (12.7%)	1 (1.8%)		5 (9.1%)	1.113
Piaget model for sci. instruct.	18 (32.7%)	26 (47.3%)	7 (12.7%)	1 (1.8%)	3 (5.5%)	1.827
Elementary Science Study (ESS)	20 (36.4%)	26 (47.3%)	7 (12.7%)	1 (1.8%)	1 (1.8%)	1.796
Science Curriculum Improvement Study (SCIS)	13 (23.6%)	24 (43.6%)	14 (25.5%)	3 (5.5%)	1 (1.8%)	2.130
Science: A Process Appr. (SAPA)	11 (20.0%)	22 (40.0%)	13 (23.6%)	6 (10.9%)	3 (5.5%)	2.269
Nature of Science	21 (38.2%)	18 (32.7%)	9 (16.4%)	4 (7.3%)	3 (5.5%)	1.923
General Questioning Strategies	24 (43.6%)	22 (40.0%)	6 (10.9%)	1 (1.8%)	2 (3.6%)	1.698
Operational Questions	15 (27.3%)	23 (41.8%)	6 (10.9%)	6 (10.9%)	5 (9.1%)	2.020
Open-eneded vs. close-ended questions	18 (32.7%)	24 (43.6%)	5 (9.1%)	4 (7.3%)	4 (7.3%)	1.902
Wait-time	12 (21.8%)	26 (47.3%)	5 (9.1%)	7 (12.7%)	4 (7.3%)	2.098
How to write science objectives	12 (21.8%)	27 (49.1%)	9 (16.4%)	3 (5.5%)	4 (7.3%)	2.059
Evaluation procedures in sci.	14 (25.5%)	28 (50.9%)	8 (14.5%)	2 (3.6%)	3 (5.5%)	1.962
Classroom manage. for science	15 (27.3%)	28 (50.9%)	7 (12.7%)	2 (3.6%)	3 (5.5%)	1.923
Construction of lesson plans	17 (30.9%)	24 (43.6%)	8 (14.5%)	3 (5.5%)	3 (5.5%)	1.942
Adapt textbook to children's stage of intellectual dev.	11 (20.0%)	26 (47.3%)	9 (16.4%)	5 (9.1%)	4 (7.3%)	2.157
Taxonomy of learning	11 (20.0%)	17 (30.9%)	17 (30.9%)	8 (14.5%)	2 (3.6%)	2.415
Working in mainstreaming sit.	8 (14.5%)	15 (27.3%)	18 (32.7%)	12 (21.8%)	2 (3.6%)	2.642
Inquiry teaching	31 (56.4%)	15 (27.3%)	6 (10.9%)		3 (5.5%)	1.519
Learning ctrs. use/construction	16 (29.1%)	25 (45.5%)	10 (18.2%)	2 (3.6%)	2 (3.6%)	1.963
Environmental/outdoor education	18 (32.7%)	19 (34.5%)	14 (25.5%)	2 (3.6%)	2 (3.6%)	2.000
Health education	11 (20.0%)	11 (20.0%)	24 (43.6%)	7 (12.7%)	2 (3.6%)	2.509
Energy education	4 (7.3%)	20 (36.4%)	21 (38.2%)	8 (14.5%)	2 (3.6%)	2.623
Marine education	3 (5.5%)	16 (29.1%)	16 (29.1%)	17 (30.9%)	3 (5.5%)	2.904
Exemplary concepts in earth science applicable to elementary school	9 (16.4%)	17 (30.9%)	17 (30.9%)	8 (14.5%)	4 (7.3%)	2.471
Exemplary concepts in physical science applic. to elem. school	9 (16.4%)	27 (49.1%)	7 (12.7%)	7 (12.7%)	5 (9.1%)	2.240
Projects other than lesson plans	9 (16.4%)	21 (38.2%)	3 (5.5%)	1 (1.8%)	21 (38.2%)	1.882

There is a wide variation in elementary science methods content courses among the New England respondents. More then 3/4 of the respondents focus upon science processes in their elementary science methods courses. The six topics with the highest priorities were; science processes, inquiry teaching, general questioning strategies, ESS, Piaget model for science instruction, and projects other than lesson plans. The six topics with the lowest priority were; marine education, working in a mainstreaming situation, energy education, health education, exemplary concepts in earth science applicable to elementary school, and taxonomy of learning. Miner (1982) reported that 2/3 of elementary science methods emphasized the processes of science.

Several interesting observations can be made about various topics. Regarding the government-sponsored programs, ESS receives considerably more emphasis than does SCIS and/or SAPA. This could be because ESS was developed in New England and is the only curricula that is still viable. There is greater emphasis on providing a theoretical background about Piaget than on how to adapt textbooks to children's stages of intellectual development which is an application of Piaget's work. Inquiry teaching and general questioning strategies ranked as the second and third highest priority. However, wait-time had a priority of 16. Science content (i.e., earth science and physical science) were low for the responding faculty. Through a proofreading oversight, biological science was not included on the final survey. Consequently, no comparison was possible.

Other elementary science methods topics mentioned were:

Micro-teaching	9
Field observations/experiences	7
Unit development	6
Field trips/resource utilization	4
Utilizing everyday things in kits	4
Computer applications	3
Textbook analysis	3
Design experiments/instruct. mat.	2
Flanders Interaction Analysis	1
Precision teaching	1
Biological applications	1

3. THIS ITEM WAS NOT ANALYZED BECAUSE TOO FEW RESPONDENTS COMPLETED IT APPROPRIATELY.

4. AT WHAT PHASE(S) OF YOUR TEACHER EDUCATION ARE ELEMENTARY EDUCATION MAJORS PROVIDED WITH CLINICAL EDUCATION EXPERIENCES IN TEACHING SCIENCE?

No clinical education experiences in science provided	4 (7.4%)
Prior to methods class	1 (1.9%)
During the methods class	6 (11.1%)
Both within the methods class and during student teaching	32 (59.3%)
During all phases of the teacher education program	7 (13.0%)
No response	4 (7.4%)

Almost 70% of the respondents are providing clinical experiences in science during the elementary science methods course and/or student teaching. The overall trend has been toward field-based experiences.

5. DID YOU ATTEND A NATIONAL SCIENCE TEACHERS (NSTA) CONVENTION IN THE LAST TWO YEARS?

Yes	17 (31.5%)
No	37 (68.5%)

DID YOU MAKE A PRESENTATION AT IT?

Yes	12 (22.2%)
No	34 (63.0%)
No Response	8 (14.8%)

Although less than 1/3 of the respondents attended a NSTA convention, 70% of those attending made a presentation. Since there has not been a NSTA convention in the New England region since 1979, the attendees had to travel outside the region.

6. DO YOU UTILIZE THE JOURNAL SCIENCE AND CHILDREN IN YOUR ELEMENTARY SCIENCE METHODS CLASS?

Yes	31 (57.4%)
No	23 (42.6%)

DO YOU PERSONALLY READ IT REGULARLY?

Yes	30 (55.6%)
No	23 (42.6%)
No Response	1 (1.9%)

IS THE JOURNAL NEW TO YOU?

Yes	7 (13.0%)
No	47 (87.0%)

Science and Children, a professional journal of NSTA, is designed for elementary school teachers of science. The vast majority of responding elementary science methods faculty are acquainted with Science and Children. Slightly over half of the faculty read it regularly and utilize it in their classes. Science and Children provides an additional resource for slightly more than half the respondent teacher education graduates.

7. DURING THE PAST TWO YEARS, HOW MANY ARTICLES HAVE YOU PUBLISHED?

None	36 (66.7%)
1	7 (13.0%)
2	4 (7.4%)
3	2 (3.7%)
4	0 (0.0%)
5	1 (1.9%)
More than 5	2 (3.7%)
No Response	2 (3.7%)

Two-thirds of the respondents have not had a journal article published in the past two years. Less than 10% of the faculty have published three or more articles in the past two years. The journals in which they published were:

The Science Teacher	3
Science and Children	2
Current	2
Nature	1
Canadian Journal of Science Education	1
Journal of Staff Development	1
Journal of Environmental Education	1
Science Activities	1
School Science and Mathematics	1
Childhood Education	1
Early Education	1
ERIC	1
Sanctuary	1
Madison Wisconsin Teacher Center Journal	1
Journal of Teacher Education	1
Science Education	1
Journal of Research in Science Teaching	1
Phi Delta Kappan	1
American Journal of Physics	1
School Review	1
Learning	1
Arithmetic Teacher	1
Journal of Morphology	1

Eleven of the 23 journals have a science and/or science education focus. It is possible that others included a science-related article.

8. PLEASE LIST THE AUTHOR'S LAST NAME, THE TITLE, AND THE PUBLISHER OF THE TEXTBOOK(S) USED WITH YOUR SCIENCE METHODS COURSE(S). (CIRCLE THE AUTHOR'S NAME FOR THE REQUIRED TEXT.)

Textbook Title/Authors	Science Education Terminal Degree Yes	No
None	4	6
Elementary School Science & How to Teach It/Blough & Swartz	2	5
Sciencing/Cain & Evans	4	1
Teaching Children Science/Abruscato	1	4
Teaching Elementary Science/Esler	2	2
Teaching Modern Science/Carin & Sund	4	
Science for Elementary School/Victor	1	3
Teaching Science With Everyday Things/Schmidt & Rockcastle	1	2
Science Activities for Children/Jacobsen		2
Science in the Elementary School/Gega		2
Learning Science Process Skills/Funk, et al.	2	
ESS Reader		2
Teaching Elementary Science/Lansdown, et al.	1	1
Creative Sciencing/DeVito & Krockover		2
Elementary School Science: Why and How/George		1
Science with Children/Trojack	1	
Teaching Science as Continuous Activity/Rowe	1	
Science with Young Children/Gene-Holt		1
Piaget's Theory of Intellectual Development/Ginsburg & Opper		1
Exploring Science in the Elementary School/Rauchek & Egger		1
Science for Early Childhood Education/		1
Science Anxiety and Classroom Teacher/Orlich		1
Choosing a Science Program for the Elementary School/Hausman		1
Resources for Creative Teaching in Early Childhood/Fleming		1
Logic of Action/Hawkins		1
Science Experiments for Early Childhood Years/Harlan		1
Biology as Inquiry/Voss	1	
Sourcebook for Elementary Science/Hall		1
Biology; Unity and Diversity	1	

For elementary science methods faculty trained in science education, the two most popular methods textbooks were Sciencing and Teaching Modern Science. For responding faculty who are not science education specialists, the two most popular textbooks were Elementary School Science and How to Teach It and Teaching Children Science. The faculty who did not receive their terminal degree in science education had almost twice as diverse a list of textbooks as the science education specialists. Part of this diversity could be because some institutions teach science methods as a component of another course. It was surprising that six non-specialists utilized no textbooks.

9. IN YOUR INSTITUTION'S ELEMENTARY EDUCATION PROGRAM, HOW MUCH EMPHASIS IS PLACED ON THE FOLLOWING SCIENCE AREAS (EXCLUDING METHODS)?

	Much	Some	Little	Don't Know	No Response
Science Content					
Faculty	10 (18.5%)	33 (61.1%)	8 (14.8%)	1 (1.9%)	4 (3.7%)
Administrators	29 (29.2%)	39 (54.2%)	7 (9.7%)	1 (1.4%)	4 (5.6%)
Science Process and Methods					
Faculty	29 (53.7%)	13 (24.1%)	7 (13.0%)	2 (3.7%)	3 (5.6%)
Administrators	27 (37.5%)	35 (48.6%)	5 (6.9%)	2 (2.8%)	3 (4.2%)
Science Teaching Techniques					
Faculty	29 (53.7%)	15 (27.8%)	7 (13.0%)	1 (1.9%)	2 (3.7%)
Administrators	23 (31.9%)	36 (50.0%)	8 (11.1%)	1 (1.4%)	4 (5.6%)

In comparison with the New England institution administrators, there is less science content emphasis in the faculty's perception. Faculty perceive that much more science process and methods and science teaching techniques are taught to preservice elementary education majors than is perceived by administrators. Faculty perceive greater emphasis in science process and methods and science teaching techniques than science content by about a three to one ratio.

10. DO YOU THINK YOUR SCIENCE CREDIT HOUR REQUIREMENT FOR PRESERVICE ELEMENTARY EDUCATION SHOULD BE CHANGED?

	No Change Needed	More is Needed	Less is Needed	No Response
Science Content				
Faculty	20 (37.0%)	30 (55.6%)	1 (1.9%)	3 (5.6%)
Administrators	36 (50.0%)	30 (41.7%)	1 (1.4%)	5 (6.9%)
Science Processes and Methods				
Faculty	20 (37.0%)	30 (55.6%)	1 (1.9%)	3 (5.6%)
Administrators	31 (43.1%)	31 (43.1%)	2 (2.8%)	8 (11.1%)
Science Teaching Techniques				
Faculty	27 (50.0%)	23 (42.6%)	1 (1.9%)	3 (5.6%)
Administrators	34 (47.2%)	28 (38.9%)	2 (2.8%)	8 (16.1%)

Elementary science methods faculty feel more science content and science processes and methods courses are needed by their graduates than is perceived by administrators of New England teacher education institutions. Faculty and administrators had similar perceptions about science teaching techniques and had about equal opinion regarding "no change needed" and "more is needed."

11. WHERE IS YOUR SCIENCE METHODS COURSE FOR ELEMENTARY EDUCATION MAJORS TAUGHT?

In a university classroom or setting	31 (57.4%)
In a school classroom or setting (field based only)	1 (1.9%)
Both in a university setting and a school setting	21 (38.9%)
No Response	1 (1.9%)

Slightly more than half of the respondents teach their elementary science methods in a higher education locality.

12. DURING THE PAST FIFTEEN MONTHS, HOW MANY IN-SERVICE SESSIONS IN THE TEACHING OF SCIENCE HAVE YOU CONDUCTED?

None	23 (42.6%)
1-3	12 (22.2%)
4-7	9 (16.7%)
8-10	3 (5.6%)
More than 10	6 (11.1%)
No Response	1 (1.9%)

Almost 2/3 of the responding faculty conducted three or less in-service sessions on the teaching of science. Slightly more than 1/3 of the faculty conducted four or more workshops. The topics for the science in-service sessions included:

Hands-on/Processes	11
Science content (i.e. biology, astronomy,etc.)	6
Implementing curriculum (i.e. ESS, OBIS, etc.)	4
Methods and materials/Curriculum Development	4
Gifted and talented	3
Development of Reasoning/Learning Cycle	2
Computers in Science	2
Improving teaching strategies	2
Science fairs	2
Creativity and Science	2
Environmental Education/Natural History	2
Content analysis	1
Reading Skills in Science	1
Architecture	1
Energy Education	1

13. DURING THE PAST FIFTEEN MONTHS, HOW MANY IN-SERVICE SESSIONS IN NON-SCIENCE TOPICS HAVE YOU CONDUCTED?

None	23 (42.6%)
1-3	13 (24.1%)
4-7	10 (18.5%)
8-10	1 (1.9%)
More than 10	4 (7.4%)
No Response	3 (5.6%)

About 2/3 of the responding elementary science methods faculty conducted three or less in-service sessions on non-science teaching topics. The number of non-science sessions conducted is almost identical with the number of science in-service sessions conducted. The non-science in-service session topics included:

Computers	6
Instructional strategies/questioning	5
Learning theories/cognitive dev.	5
Math teaching strategies	2
Parent education	2
Early Childhood integration	2
Creativity/Problem-solving	2
Evaluation Measurement	2
Personal decision-making/time manage.	2
Energy education/acid rain	2
School improvement	1
Interpretative theatre	1
Mainstreaming	1
Adult education	1
Recycling	1
Working with student teachers	1
Language development	1
Gifted and talented	1
Children's literature	1
Nutrition	1
Textbook selection	1
Stress and teacher burnout	1
Manipulatives	1

14. ALL THINGS CONSIDERED HOW COULD YOUR INSTITUTION BETTER PREPARE ELEMENTARY TEACHER CANDIDATES TO TEACH SCIENCE?

There were two items mentioned most frequently by the responding elementary science methods faculty. Fifteen respondents recommended that their teacher candidates should have more science content courses and that they be exposed to biological, earth, and physical science content. The second most common response (11 faculty) was the recommendation to provide more time/credit for elementary science methods course. The vast majority of these respondents was where science methods are currently integrated with another methods area in one course (i.e., math and science methods).

The other recommendations were mentioned less frequently. They included:

Require science to be taught during student teaching	7
Specific science courses for education majors	5
Full time science methods faculty	4
Science field practicum	3
More/better quality library resources	3
More clinical experiences	2
Combine methods with science content courses	2
Courses should have problem-solving emphasis	2
Faculty have greater involvement with K-6 schools	2
Higher entrance requirement prior to education candidacy	1
Computers	1
Science methods earlier in program	1
Method course focus upon unit development	1
Special program to prepare middle school science teachers	1
Establish lab school	1
Require more mathematics content	1
More funds to operate program	1
Work for more NSF funding	1
Better K-6 science model teacher	1
Exchange course syllabi to promote articulation	1
Methods course should focus upon K-6 science activities	1

Demographic

1. WHAT IS YOUR CURRENT RANK?

Instructor	4 (7.4%)
Assistant Professor	6 (11.1%)
Associate Professor	16 (29.6%)
Professor	16 (29.6%)
Lecturer	5 (9.3%)
Adjunct Faculty	5 (9.3%)
Faculty	1 (1.9%)
No Response	1 (1.9%)

Almost 3/5 of the responding elementary science methods faculty are at the senior levels. More than 1/4 of the faculty have a rank lower than assistant professor (instructor, lecturer, and adjunct faculty).

2. DO YOU HAVE TENURE?

Yes	29 (53.7%)
No	23 (42.6%)
No Response	2 (3.7%)

IF NO, ARE YOU ON A TENURE TRACK?

Yes	9 (16.7%)
No	13 (24.1%)
No Response	33 (59.2%)

Almost 40% of the responding elementary science methods faculty who do not have tenure are on a tenure track. Slightly over half of the respondents currently have tenure at their institution.

3. WHAT IS YOUR CURRENT POSITION?

Full-time	43 (79.6%)
Part-time	10 (18.5%)
No Response	1 (1.9%)

Almost 4/5 of the elementary science methods faculty have a full-time appointment with their institution.

4. HOW MANY YEARS HAVE YOU TAUGHT PRESERVICE ELEMENTARY SCIENCE METHODS (INCLUDING THE 1982-83 YEAR)?

1	7 (13.0%)
2	3 (5.6%)
3	4 (7.4%)
4	1 (1.9%)
5	2 (3.7%)
6	2 (3.7%)
7	4 (7.4%)
8	4 (7.4%)
10	2 (3.7%)
11	4 (7.4%)
12	3 (5.6%)
13	1 (1.9%)
14	3 (5.6%)
15	7 (13.0%)
16	2 (3.7%)
17	2 (3.7%)
20	1 (1.9%)
30	2 (3.7%)

Almost 1/3 of the responding faculty have been teaching an elementary science methods course for five years or less. About 25% of the faculty have been teaching a course for preparing elementary science teachers since 1968. The mean number of years teaching elementary science methods courses was 9.574 years.

5. HOW MANY YEARS HAVE YOU TAUGHT AT YOUR CURRENT INSTITUTION (INCLUDING THE 1982-83 YEAR)?

1	4 (7.4%)
2	3 (5.6%)
3	5 (9.3%)
4	1 (1.9%)

5	1 (1.9%)
6	2 (3.7%)
7	1 (1.9%)
8	1 (1.9%)
9	2 (3.7%)
10	1 (1.9%)
11	5 (9.3%)
12	6 (11.1%)
13	4 (7.4%)
14	3 (5.6%)
15	5 (9.3%)
16	5 (9.3%)
17	1 (1.9%)
20	1 (1.9%)
23	1 (1.9%)
26	1 (1.9%)
41	1 (1.9%)

About 25% of the elementary science methods faculty have been at their current institution five years or less. About 1/3 of the faculty have been at their current institution 15 years or more. Faculty have been at their current institution longer on the average than they have taught elementary science methods courses (10.963 versus 9.574).

6. GENDER

Female	18 (33.3%)
Male	35 (64.8%)
No Response	1 (1.9%)

About 1/3 of responding elementary science methods faculty are women.

7. AGE

33	1 (1.9%)
35	1 (1.9%)
36	2 (3.7%)
37	2 (3.7%)
38	2 (3.7%)
39	2 (3.7%)
40	3 (5.6%)
42	4 (7.4%)
43	2 (3.7%)
44	4 (7.4%)
45	2 (3.7%)
47	3 (5.6%)
48	5 (9.3%)
49	1 (1.9%)
50	2 (3.7%)
51	3 (5.6%)

52	3 (5.6%)
53	2 (3.7%)
54	1 (1.9%)
56	1 (1.9%)
57	1 (1.9%)
60	1 (1.9%)
61	1 (1.9%)
62	1 (1.9%)
65	1 (1.9%)
69	1 (1.9%)
No Response	2 (3.7%)

The mean age for elementary science methods faculty was 46.865 years with a standard deviation of 7.976. The median age of the faculty was 47. Based upon a retirement age of 70, by the year 2,000 slightly more than 16% of the current faculty will have retired.

Based upon the median age, the average faculty was born in 1936 and was graduating from college at the launching of Sputnik I. These individuals have seen the cyclic changes of science education over the past 26 years. The youngest faculty member probably entered elementary school prior to the launching of Sputnik I. The seven oldest faculty members have lived since Gerald Craig wrote his dissertation which has served as the basis for elementary science education since 1927.

Conclusions

1. Less than 40% of responding elementary science methods faculty have their terminal degree in science education.
2. More than 75% of respondents have some elementary school teaching experience. More respondents have intermediate experience than have early childhood experience.
3. Respondents had more science preparation than science education.
4. Elementary science methods faculty have more of a generalist teaching responsibility. The typical faculty member teaches less than two elementary science methods classes per year. Faculty teach other

education courses almost as frequently as they do elementary science methods classes. The responding faculty have on the average of more than three preparations while supervising more than seven student teachers per semester.

5. The highest content emphasis for the elementary science methods classes was on science processes, inquiry teaching, general questioning strategies, ESS, and Piagetian model. The respondents assigned low priorities to marine education, working in mainstreaming situations, energy education, health education, exemplary concepts in earth science applicable to elementary school, and taxonomy of learning.
6. In comparison with New England administrators, faculty perceive less content emphasis and more science processes and methods and science teaching techniques. More responding faculty perceived their teacher candidates needs to be science content and science processes and methods than did administrators.
7. Only about 1/3 of the respondents had a manuscript published in the past two years. Regarding inservice workshops, about 1/3 of the respondents conducted more than three workshops on teaching of science and three workshops on non-science teaching topics.
8. The typical respondents were senior level faculty members who are full-time employees. Respondents have taught elementary science methods courses for more than nine years on the average and have been at their current institutions for an average of about 11 years.

CONCLUDING REMARKS

This study examined New England preservice programs for the preparation of elementary science teachers. Data was gathered from School of Education Chairpersons, campus library directors, and elementary science methods faculty. The recently adopted guidelines for the preparation of elementary science teachers (NSTA, 1983) served as bench mark comparisons. Specifically, this document recommended that 12 semester hours of science content courses be required. However, less than 20% of the responding institutions currently require this amount of preparation. Approximately 14% of responding elementary science methods faculty have taken nine semester hours of science content courses or less since their bachelor's degree and more than one third have taken nine semester hours of science education courses or less since they received their bachelor's degree. It is possible that some of the elementary science methods faculty fail to meet the 12 hours science content requirement recommended by NSTA. Especially since the majority of faculty are graduates of New England institutions, currently more than one sixth of which do not require their graduates to have any science content courses. Also, more than one fourth of these institutions fail to offer an elementary science methods course in their undergraduate program.

Schools of Education Chairpersons were aware of the weaknesses in the preparation of their undergraduates to teach elementary school science but they failed to identify the need for competent elementary science methods faculty. More than three fifths of the responding facultys' terminal degrees were in a non-science education discipline. More than three fourths of the responding faculty have the elementary school teaching experiences recommended by NSTA. Responding faculty members' recommendations to improve elementary science education at their institutions were very similar to the administrators' recommendations.

Library directors are aware of the limited and out-of-date resources they have available for undergraduates. More than 30% of the responding library directors indicated they do not receive Science and Children. This is rather discouraging since this journal is prepared for elementary science teachers. In addition, almost 60% of the 1983 Search for Excellence in Elementary Science Education award winners identified Science and Children as an important resource in their staff development efforts (Penick, 1983).

The focus of the National Science Board report (1983) was upon K-12 science education. One of the ways to address the crisis is by providing quality preservice science instruction for preservice teachers. New England is unique because of the area's large number of very small teacher education programs. One of the victims could be elementary science educators. Less than two fifths of the elementary science methods faculty have their terminal degree in science education. Consequently, future elementary science teachers are not being prepared to teach science education by qualified faculty. The lack of specialization in science education has resulted in generalists teaching elementary science methods courses. About one fifth of responding faculty have never taught in an elementary school; therefore, students might perceive their science methods courses as nonrelevant.

The recommendation by Donnellan (1982) is still relevant: "Faculty assigned to teach science content and methods courses for preservice elementary science teachers should have the qualifications, experience, and interest to provide high quality instruction" (p. 11). Unfortunately, many New England teacher education institutions and elementary science methods faculty fail to meet the needs for preparing quality elementary science teachers. If science education is not given a positive status at a higher education institution, can teacher candidates be expected to recognize its status? Are future teachers prepared to teach elementary science education when

their course work fails to focus upon the content, process, and attitudes of science? How can future teachers be prepared to teach elementary science and prepare their students to be scientifically literate when science is not provided in their programs?

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New England Teacher Education Institutions
Surveyed and Returned

State	Administrator	Librarian	Teacher
Connecticut			
Central Connecticut State College	X	X	X
Connecticut College	X		X
Eastern Connecticut State College	X	X	X
Sacred Heart University	X	X	X
Saint Joseph University	X	X	X
Southern Connecticut State College			
University of Bridgeport	X	X	X
University of Connecticut	X	X	X
University of Hartford	X		
Western Connecticut State College	X	X	
Maine			
St. Joseph College	X	X	
University of Maine - Farmington	X	X	X
University of Maine - Fort Kent	X	X	X
University of Maine - Machias	X	X	X
University of Maine - Orono	X	X	X
University of Maine - Presque Isle	X	X	X
University of New England	X	X	
University of Southern Maine	X	X	X
Massachusetts			
American International College	X	X	
Anna Maria College	X		
Assumption College	X	X	
Atlantic Union College			X
Berkshire Christian College	X	X	X
Boston College	X	X	a
Boston University	X	X	X
Brandeis University	X		
Bridgewater State	X	X	X
Clark University	X		
College of Our Lady of Elms	X	X	X
Curry College	X	X	
Eastern Nazarene College	X		X
Emmanuel College		X	
Fitchburg State College	X	X	
Framingham State College	X	X	X
Gordon College	X	X	
Hampshire College		X	X
Hellenick College		X	a
Lesley College			X
Harvard		X	a

State	Administrator	Librarian	Teacher
Massachusetts - continued			
Mt. Holyoke College	X	X	
North Adams State College	X		X
Northeastern University		X	
Regis College		X	a
Salem State College		X	X
Simmons College	X	X	X
Smith College		X	a
Southeastern Massachusetts University	X	X	X
Stonehill College		X	X
Springfield College	X	X	X
Suffolk University	X	X	X
Tufts University		X	X
University of Lowell	X	X	X
University of Massachusetts - Amherst	X	X	X
University of Massachusetts - Boston		X	X
Westfield State College	X	X	a
Wheaton College	X		a
Worcester State College		X	
New Hampshire			
Antioch	X		X
Colby-Sawyer College	X	X	a
Dartmouth College	X	X	a
Franklin Pierce College	X	X	X
Keene State College	X	X	X
New England College	X		
Notre Dame College	X		X
Plymouth State College	X	X	X
Rivier College	X	X	X
University of New Hampshire	X	X	
Upper Valley Teacher Training Program			a
Rhode Island			
Barrington College	X	X	X
Rhode Island College	X	X	X
Salve Regina	X		X
University of Rhode Island	X	X	
Vermont			
Castleton State College	X	X	X
College of St. Joseph		X	
Goddard College	X		a
Green Mountain College	X		a
Johnson State College		X	X
Lyndon State College	X	X	X
Middlebury College	X		X

State	Administrator	Librarian	Teacher
Vermont - continued			
Norwich University	X	X	a
Prospect School			a
St. Michaels College	X		X
Trinity College	X	X	X
University of Vermont	X	X	X

X = returned a = no science methods course offered

UNIVERSITY OF MAINE *at Orono*

College of Education

Shibles Hall
Orono, Maine 04469
207/581-2430

The early 1980's has been identified as a period of crisis in science education. A recent study by the National Science Foundation found that the overwhelming majority of elementary teachers felt "not well qualified" to teach science. Another study reported that fewer than half of the nation's elementary school children received only one year of science in their elementary education in which their teacher gave science a substantial share of the curriculum and the teacher did a good job of teaching science. The remaining elementary children had less than this one year of quality science. The National Science Teachers Association recently surveyed 50 major higher education institutions to determine how they prepared elementary majors to teach science. Only 4% of these surveyed institutions were located in New England. The purpose of this research project is to ascertain how all New England higher education institutions prepare their preservice teachers to teach elementary science. Your state department of education identified you as your institutional contact person.

I would appreciate it if you would take 15-20 minutes to complete the enclosed questionnaire. If, after examining the questionnaire, you feel that there is someone else at your institution who would be able to respond more accurately, please ask them to complete the questionnaire. A stamped return envelope has been provided. Please return the questionnaire by April 4, 1983. If you have questions or need clarification on any of the items, feel free to contact me. My office telephone number is (207) 581-2436.

Thank you in advance for your cooperation.

Sincerely,

Lloyd H. Barrow, Ph.D.
Associate Professor of
Science Education

Enc.

THE LAND GRANT UNIVERSITY AND SEA GRANT COLLEGE OF MAINE

UNIVERSITY OF MAINE *at Orono*

College of Education

Shibles Hall
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April 13, 1983

Dear

As you may recall, approximately three weeks ago, I mailed you a questionnaire relating to New England preservice science education. Specifically, the study is to investigate the practices and trends of all New England higher education institutions. In addition, questionnaires have been prepared to get information from preservice elementary science methods teachers and library resources.

So far I have received a 60% return of the questionnaires, but would like to increase this figure to 100%. I am enclosing another copy of the questionnaire which I hope you will complete. Please return your questionnaire by April 22, 1983. The return of this survey is necessary to contact library and elementary science methods professors. If you have already returned your questionnaire, thank you for your participation. If you would like to receive a copy of the final report, please fill in the information at the end of the questionnaire.

Thank you for your cooperation.

Sincerely,

Lloyd H. Barrow

Lloyd H. Barrow
Associate Professor
Science Education

Enc.

LHB/ms

THE LAND GRANT UNIVERSITY and SEA GRANT COLLEGE OF MAINE

New England Preservice Elementary Science
Education Questionnaire: Administration

This questionnaire is designed to be completed by the Dean or an appropriate administrator designee within the School of Education or other academic unit responsible for the preservice preparation of teachers of science in the elementary schools.

Institution Name and Address:_____

_____

Part I: Introductory

1. My institution prepares undergraduate elementary teachers?

   Yes_____ No_____

2. My institution provides graduate courses for elementary teachers?

   Yes_____ No_____

   If you responded Yes to either question 1 or 2, please complete the remaining questions by marking the appropriate blanks.

   If you answered No to both of the above questions, do not answer any further questions and return the questionnaire in the stamped return envelope. If you want a copy of the final report, fill in the appropriate information on the last page.

Part II: Elementary Teacher Preparation

1. The elementary education graduates from your institution are certified to teach in which category?

   _____K - 6 _____K - 8 _____Other: specify_____

2. Which of the following describes your college or university?

   _____ A public institution
   _____ A private institution, church affiliated
   _____ A private institution, non-church affiliated

3. Which of the following best describes the trend in yearly numbers of undergraduate elementary education majors graduated from your institution during the past five years?

   _____Sharply decreased
   _____Sharply decreased, then leveled off
   _____Moderately decreased
   _____Remained fairly steady
   _____Moderately increased
   _____Sharply increased

Over

4. What are the minimum number of science hours required in your elementary education program (excluding the science methods course)?_____

   Are these semester or quarter hours?_____

5. Are your elementary education majors required to take an elementary science methods course? Yes_____ No_____
   Recommended? Yes_____ No_____
   If recommended, what percent of the majors elect the science methods?
   _____%.

6. Which of the following changes has the science component of your elementary education program undergone during the past five years? (Check all that apply).

   _____Fewer course offerings
   _____Increased course offerings
   _____Smaller class or section size
   _____Larger class or section size
   _____Decreased number of credits per course
   _____Increased number of credits per course
   _____Decreased science education budgets relative to other components of teacher education
   _____Increased science education budgets relative to other components of teacher education
   _____Other: please specify_____

7. Are elementary teacher candidates required to take science courses as a part of their general education requirements, their professional education requirements or both?

   _____General education
   _____Professional Education
   _____Both

8. In which of the following <u>areas</u> are elementary teacher candidates required to take courses?

   _____Physical sciences
   _____Biological sciences
   _____Earth sciences
   _____Any of the above may be elected
   _____All of the above are required
   _____Other, please describe_____
   _____

9. How many of the science content courses required of elementary education majors must include laboratory work? (Check one)

   _____None
   _____One
   _____Two
   _____Other: please specify_____

10. Are specific science courses excluding science methods required?
_____ Yes _____No

If yes, please give course titles and credits.

Titles	Credits
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

11. If science courses are required, are they designed specifically to meet the needs of preservice elementary teachers?
_____Yes _____No ____Other, please explain_____

_____

12. Do elementary teacher candidates usually elect additional science courses on their own? _____Yes _____No

13. Do the science courses taken by the elementary teacher candidates include laboratory experiences and activities in addition to lecture?
_____Yes _____No

14. In your estimation, what factors have had the most influence in determining the science and/or science teaching methods course requirements for elementary teacher candidates at your institution? (Check all that apply)
_____Tradition
_____Accreditation agencies such as NCATE
_____State certification guidelines
_____Professional Science Association guidelines
_____Other, please describe_____
_____

15. In your program, how much emphasis is currently placed on the following science education areas?

Science Content:	_____Much	_____Some	_____Little	_____Don't know
Science Process and Methods:	_____Much	_____Some	_____Little	_____Don't know
Science Teaching Techniques:	_____Much	_____Some	_____Little	_____Don't know

16. Do you think your science credit hour requirements for preservice elementary should be changed?

Science Content:	___No Change Needed	___More Is Needed	___Less Is Needed
Science Process and Methods:	___No Change Needed	___More Is Needed	___Less Is Needed
Science Teaching Techniques:	___No Change Needed	___More Is Needed	___Less Is Needed

Over

17. As you consider your total program for preparing preservice elementary teachers for teaching science, how would you rate its overall effectiveness?

_____Excellent ____Good ____Adequate ____Poor ____Don't know

18. Number of elementary education majors that graduated from your institution in 1982.

Undergraduate_____ Graduate (if appropriate)_____

19. What is your full-time enrollment during the 1982-83 academic year in the School of Education?

Undergraduate_____ Graduate (if appropriate)_____

If you do not have a graduate program, omit question 20.

20. Are all elementary graduate students required to complete a science education course? _____Yes _____No If Yes, please describe the course(s):_____

_____

_____

_____

21. My institution's elementary education program is currently: (Check all that apply)

_____New England Association of Schools and Colleges approved
_____NCATE approved
_____State Certification approved
_____Currently on probation
_____Other: please specify_____

22. Is your institution currently redesigning their undergraduate elementary education program? _____Yes _____No. If yes, summarize the modifications that will influence science education preparation for elementary preservice teachers.

_____

_____

_____

_____

_____

_____

23. To what extent does your program evaluate the effectiveness of your elementary teacher preparation program in science education by follow-up studies of your graduates? (Check one)

_____None
_____Little
_____Moderate
_____Extensive

If you do follow-up studies of your graduates, which of the following method(s) do you use for the evaluation? (Check all that apply)

_____Informal discussion and contacts
_____Written questionnaires sent to graduates
_____Classroom visitations of teacher graduates
_____Return visits by graduates

24. All things considered, how could elementary teacher candidates be better prepared to teach science at your institution?

_____

_____

_____

_____

_____

25. Part of this study is to determine the library resources available for use by elementary education majors. S/he will be receiving a one page survey to complete. Your institutional director of the library is:

_____

_____

_____

_____

Over

26. Please list the name(s), title and address of individuals that have taught elementary science method courses at your institution during the 1982-83 school year. Each individual will receive a survey concerning their experiences and preparation in science education.

_____

_____

_____

_____

_____

_____

_____

Comments:

Thank you for your cooperation.

If you would like a copy of the results of this research, please complete the following information:

Name_____Title:_____

Institution_____Address_____

City_____State_____Zip_____

APPENDIX C

UNIVERSITY OF MAINE *at Orono*

College of Education

Shibles Hall
Orono, Maine 04469
207 581-2420

March 25, 1983

Dear

The early 1980's has been identified as a period of crisis in science education. A recent study by the National Science Foundation found that the overwhelming majority of elementary teachers felt "not well qualified" to teach science. Another study reported that fewer than half of the nation's elementary school children received only one year of science in their elementary education in which their teacher gave science a substantial share of the curriculum and the teacher did a good job of teaching science. The remaining elementary children had less than this one year of quality science. The National Science Teachers Association recently surveyed 50 major higher education institutions to determine how they prepared elementary majors to teach science. Only 4% of those surveyed institutions were located in New England. The purpose of this research project is to ascertain how all New England higher education institutions prepare their preservice teachers to teach elementary science. None of the above studies investigated the library resources available at higher education institutions.

I would appreciate it if you would take 5-10 minutes to complete the enclosed questionnaire. If, after examining the questionnaire, you feel that there is someone else at your institution who would be able to respond more accurately, please ask them to complete the questionnaire. A stamped return envelope has been provided. Please return the questionnaire by April 30, 1983. If you have questions or need clarification on any of the items, feel free to contact me. My office telephone number is (207) 581-2436.

Thank you in advance for your cooperation.

Sincerely,

Lloyd H. Barrow, Ph.D.
Associate Professor
Science Education

New England Preservice Elementary Science Education
Questionnaire: Library Resources

This questionnaire is designed to be completed by the director of the library or an appropriate designee who is acquainted with the education resources available for student use.

Institution Name and Address: _____

_____

Please answer the following questions about your institution's resources.

1. Indexes and materials available to students:

	Yes	Volumes Available	No
Education Index	___	_____	___
CIJE	___	_____	___
ERIC	___	_____	___
ERIC microfiche	___	_____	___
Dissertation Abstracts	___	_____	___
Computer search capabilities	___		___

2. Journals available

	Yes	Volumes Available	No
Arithmetic Teacher	___	_____	___
Early Years	___	_____	___
Health Education	___	_____	___
Instructor	___	_____	___
Language Arts	___	_____	___
The Reading Teacher	___	_____	___
J. of Research in Science Teaching	___	_____	___
School Science and Mathematics	___	_____	___
Science Activities	___	_____	___
Science and Children	___	_____	___
Science Digest	___	_____	___
Science Education	___	_____	___
Science News	___	_____	___
The Science Teacher	___	_____	___
Teacher	___	_____	___
Young Children	___	_____	___

3. Within your library, please rate the quantity of each of the following resources, which are available for your elementary education majors to use in preparing science units for use in elementary schools

	More than Adequate	Adequate	Inadequate	Not Available
Elementary Science Textbooks				
Prior to 1980 editions	___	___	___	___
1980 + editions	___	___	___	___
Nonfiction science trade books	___	___	___	___
Fiction science trade books	___	___	___	___
Resource files on current science topics	___	___	___	___
Science reference books	___	___	___	___
Audio-visual materials for science	___	___	___	___
Computer software for science	___	___	___	___

Over

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4. What resources (up to 5), in your opinion, should be added to the library if cost was not a problem to aid elementary education majors in preparing them to teach science?

_____

_____

_____

_____

_____

Comments:

Thank you for your cooperation.

If you would like a copy of the final report please complete the following information:

Name_____ Title_____

Institution_____ Address_____

City_____ State_____ Zip_____

UNIVERSITY OF MAINE *at Orono*

College of Education

Shibles Hall
Orono, Maine 04469
207/581-2420

The early 1980's has been identified as a period of crisis in science education. A recent study by the National Science Foundation found that the overwhelming majority of elementary teachers felt "not well qualified" to teach science. Another study reported that fewer than half of the nation's elementary school children received only one year of science in their elementary education in which their teacher gave science a substantial share of the curriculum and the teacher did a good job of teaching science. The remaining elementary children has less than this one year of quality science. The National Science Teachers Association recently surveyed 50 major higher education institutions to determine how they prepared elementary majors to teach science. Only 4% of these surveyed institutions were located in New England. The purpose of this research project is to ascertain how New England higher education institutions prepare their preservice teachers to teach elementary science. Of particular interest are the preparation, professional, and demographic information about New England elementary methods teachers. Your institution's education chairperson identified you as a teacher of elementary science methods.

I would appreciate it if you would take 15-20 minutes to complete the enclosed questionnaire. I would appreciate a copy of your elementary science methods course syllabus. I will be glad to return it if you so desire. If you did not teach an elementary science methods class during the 1982-83 academic year, please indicate on the first page of the survey. A stamped return envelope has been provided. Please return the questionnaire by May 4, 1983. If you have qestions or need clarification on any of the items, feel free to contact me. My office telephone number is (207) 581-2436.

Thank you in advance for your cooperation.

Sincerely,

Lloyd H. Barrow
Associate Professor
Science Education

Enc.

UNIVERSITY OF MAINE *at Orono*

College of Education

Shibles Hall
Orono, Maine 04469
207/581-2420

May 16, 1983

As you may recall, I mailed you a questionnaire relating to New England preservice science education. Specifically, the study is to investigate the practices, trends and library resources of all New England higher education institutions.

So far I have received 65% return on the questionnaires, but would like to increase this figure to 100%. I am enclosing another copy of the questionnaire which I hope you will complete. Please return your two page questionnaire by June 3, 1983. If you have already returned your questionnaire, thank you for your participation. If you would like to receive a copy of the final report, please fill in the information at the end of the questionnaire. If you have questions or need clarification on any of the items, feel free to contact me. My office telephone number is (207) 581-2436.

Thank you for your cooperation.

Sincerely,

Lloyd H. Barrow
Associate Professor
Science Education

Enc.

THE LAND GRANT UNIVERSITY AND SEA GRANT COLLEGE OF MAINE

UNIVERSITY OF MAINE *at Orono*

College of Education

Shibles Hall
Orono, Maine 04469
207 581-2420

September 12, 1983

Last spring I mailed you a questionnaire about the preparation and content of your science methods classes. Specifically, this study is attempting to investigate the practices, trends and library resources of all New England higher education institutions in science education. So far, I have not yet received your completed questionnaire.

It is extremely important that I receive at least 50% of teacher responses so that my study will be representative of those teaching science methods in New England. I am enclosing another copy of the questionnaire which I hope you will complete. Please return your questionnaire by September 30, 1983. If you would like to receive a copy of the final report, please fill in the information at the end of the questionnaire. If you have questions or need clarification on any of the items, feel free to contact me. My office telephone number is (207)581-2436.

Thank you for your cooperation.

Sincerely,

Lloyd H. Barrow
Associate Professor
Science Education

Enc.

mjs

THE LAND GRANT UNIVERSITY AND THE SEA GRANT COLLEGE OF MAINE

New England Preservice Elementary Science Education Questionnaire: Teachers

This questionnaire is designed to be completed by the professors of elementary science methods classes throughout New England.

Institution Name and Address: _____

_____

Part I: Preparation

1. Your highest degree received is: _____. Year received: _____

   Degree awarded by what institution? _____

   Are you currently pursuing an advanced degree? _____Yes _____No

2. Is your terminal degree in science education? _____Yes _____No

   If no, what was your area of concentration? _____

3. Did you ever teach in an elementary classroom? _____Yes _____No

   If yes, how many years did you teach in an elementary classroom? _____

   What grade level(s) did you teach? _____

   What was the last year you taught in an elementary classroom? _____

4. Since you completed your bachelor's degree, how many semester hours have you completed

in science?	Science Education?
___ 0 - 9	___ 0 - 9
___ 10 - 18	___ 10 - 18
___ 19 - 27	___ 19 - 27
___ more than 27	___ more than 27

Part II: Professional

1. Please summarize your course load responsibilities for the 1982-83 year. Specify number of sections for each category.

	Fall	Spring	Winter (Quarter only)
Elementary Science Methods	____	____	____
Secondary Science Methods	____	____	____
Other education course(s) (specify) _____	____	____	____
Science course(s) (specify) _____	____	____	____
Science courses for non-science majors (specify) _____	____	____	____
Supervision of student teachers (specify number _____)	____	____	____
Graduate course(s) _____	____	____	____
Research and Development	____	____	____
Other (specify) _____	____	____	____

(over)

2. Check the appropriate response for each of these categories for your elementary science methods course:

	Major emphasis	Moderate emphasis	Little emphasis	Not included
Science processes	____	____	____	____
Piaget model for science instruction	____	____	____	____
Elementary Science Study	____	____	____	____
Science Curriculum Improvement Study	____	____	____	____
Science - A Process Approach	____	____	____	____
Nature of Science	____	____	____	____
General Questioning Strategies	____	____	____	____
Operational Questions	____	____	____	____
Open-ended vs close-ended questions	____	____	____	____
Wait time	____	____	____	____
How to write science objectives	____	____	____	____
Evaluation procedures in science	____	____	____	____
Classroom management for science	____	____	____	____
Construction of lesson plans	____	____	____	____
Adapt textbook to children's stage of intellectual development	____	____	____	____
Taxonomy of learning (Bloom, Krathworl)	____	____	____	____
Working in mainstreaming situation	____	____	____	____
Inquiry teaching	____	____	____	____
Learning centers use/construction	____	____	____	____
Environmental/Outdoor education	____	____	____	____
Health education	____	____	____	____
Energy education	____	____	____	____
Marine education	____	____	____	____
Exemplary concepts in earth science applicable to elementary school	____	____	____	____
Exemplary concepts in physical science applicable to elementary school	____	____	____	____
Projects other than lesson plans	____	____	____	____
Other (please specify)	____	____	____	____
_____	____	____	____	____
_____	____	____	____	____
_____	____	____	____	____
_____	____	____	____	____
_____	____	____	____	____
_____	____	____	____	____

3. At the time your elementary education majors begin your science methods course and at the time they graduate, what do you believe is their level of understanding of each of the following topics? (circle two numbers in each row)

	Inadequate at Graduation----------	Adequate at Graduation----------	Adequate at Start of Methods----------	Inadequate at Start of Methods-------
Historical aspects of science	1	2	1	2
Philosophical aspects of science	1	2	1	2
Cultural aspects of science	1	2	1	2
Social aspects of science	1	2	1	2
Energy conservation	1	2	1	2
Environmental education	1	2	1	2
Metrics education	1	2	1	2

4. At what phase(s) of your teacher education program are elementary education majors provided with clinical education experiences in teaching science? (check one)

____No clinical education experiences in science provided
____Prior to method class
____During the methods class
____Both within the methods class and during student teaching
____During all phases of the teacher education program

5. Did you attend a National Science Teachers Convention in the last two years?
_____Yes _____No

Did you make a presentation at it? _____Yes _____No

6. Do you utilize the journal Science and Children in your elementary science methods class? _____Yes _____No

Do you personally read it regularly? _____Yes _____No

Is the journal new to you? _____Yes _____No

7. During the past two years, how many articles have you had published?

_____None
_____1
_____2
_____3
_____4
_____5
_____More than 5

List the journals you have published in:

_____

_____

_____

_____

_____

8. Please list the author's last name, the title, and the published of the textbook(s) used with your science methods course(s): (circle the author's name for the required text)

TITLE	AUTHOR'S NAME	PUBLISHER

9. In your institution's elementary education program, how much emphasis is placed on the following science areas (excluding methods)?

Science Content:	___Much	___Some	___Little	___Don't know
Science Process and methods:	___Much	___Some	___Little	___Don't know
Science Teaching Techniques:	___Much	___Some	___Little	___Don't know

10. Do you think your science credit hour requirements for preservice elementary education should be changed?

Science Content:	___No Change Needed	___More Is Needed	___Less Is Needed
Science Process and Methods:	___No Change Needed	___More Is Needed	___Less Is Needed
Science Teaching Techniques:	___No Change Needed	___More Is Needed	___Less Is Needed

11. Where is your science methods course for elementary education majors taught? (check one)

___In a university classroom or setting
___In a school classroom or setting (field based only)
___Both in a university setting and a school setting

12. During the past fifteen months, how many in-service sessions in the teaching of science have you conducted?

___None
___1-3
___4-7
___8-10
___more than 10

Briefly summarize the emphasis: _____

_____

_____

_____

13. During the past fifteen months, how many in-service sessions in non-science topics have you conducted?

____None
____1-3
____4-7
____8-10
____More than 10

Briefly summarize the topics: _____

_____

_____

_____

14. All things considered, how could your institution better prepare elementary teacher candidates to teach science?

_____

_____

_____

_____

_____

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_____

_____

(over)

Part III: Demographic

1. What is your current rank?_____

2. Do you have tenure? ____Yes ____No

   If no, are you on a tenure track? ____Yes ____No

3. What is your current position? ____full-time ____part-time

4. How many years have you taught preservice elementary science methods (including the 1982-83 year)?_____

5. How many years have you taught at your current institution (including the 1982-83 year)?_____

6. Gender: ____Female ____Male

7. Age: ____ (To be utilized to determine future needs at higher education institutions)

Comments:

Thank you for your cooperation.

If you would like a copy of the results of this research, please complete the following information:

Name_____Title_____

Institution_____Address_____

City_____State_____Zip_____